

The Direct and Enantioselective Organocatalytic  $\alpha$ -Oxidation of Aldehydes

Sean P. Brown, Michael P. Brochu, Christopher J. Sinz, and David W. C. MacMillan\*

*Division of Chemistry and Chemical Engineering, California Institute of Technology,  
Pasadena, California 91125*

## Supporting Information

**General Information.** Commercial reagents were purified prior to use following the guidelines of Perrin and Armarego.<sup>1</sup> Organic solutions were concentrated under reduced pressure on a Büchi rotary evaporator. Chloroform was distilled from calcium hydride prior to use. Chromatographic purification of products was accomplished using forced-flow chromatography on ICN 60 32-64 mesh silica gel 63 according to the method of Still.<sup>2</sup> Thin-layer chromatography (TLC) was performed on EM Reagents 0.25 mm silica gel 60-F plates. Visualization of the developed chromatogram was performed by fluorescence quenching or anisaldehyde stain.

<sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on Varian Mercury 300 (300 MHz and 75 MHz respectively) as noted, and are internally referenced to residual protio solvent signals. Data for <sup>1</sup>H are reported as follows: chemical shift ( $\delta$  ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), integration, coupling constant (Hz) and assignment. Data for <sup>13</sup>C NMR are reported in terms of chemical shift. IR spectra were recorded on a Perkin Elmer Paragon 1000 spectrometer and are reported in terms of frequency of absorption (cm<sup>-1</sup>). Mass spectra were obtained from the California Institute of Technology Mass Spectral facility. High performance liquid chromatography (HPLC) was performed on Hewlett-Packard 1100 Series chromatographs using Chiralcel AD column (1.6 x 25 cm) and AD guard (1.6 x 5 cm), Chiralcel OD-H (1.6 x 25 cm) and OD guard (1.6 x 5 cm), or Chiralcel AS (1.6 x 25 cm) and AS guard (1.6 x 5 cm) as noted.

**General Procedure:** To a 2-dram vial equipped with a magnetic stir bar and charged with L-proline was added chloroform (500  $\mu$ L) and the suspension cooled to 4 °C. The suspension was cooled for 10 minutes before nitrosobenzene (107.1 mg, 1 mmol) was added in

<sup>1</sup> Perrin, D. D.; Armarego, W. L. F. *Purification of Laboratory Chemicals*; 3<sup>rd</sup> ed., Pergamon Press, Oxford, 1988.

<sup>2</sup> Still, W. C.; Kahn, M.; Mitra, A. J. *J. Org. Chem.* **1978**, 43, 2923.

one portion upon at which time the solution becomes green. To this green heterogeneous solution was then added the appropriate aldehyde (3 mmol) in one portion. The resulting solution was then stirred at 4 °C until the reaction was determined to be complete by TLC and the disappearance of green color in solution, resulting in a final yellow homogeneous solution. The reaction mixture was then transferred to an ethanol suspension of NaBH<sub>4</sub> at 0 °C. After 20 minutes, the reaction was treated with saturated aqueous NaHCO<sub>3</sub>, extracted with dichloromethane (3 x 30 mL), dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The resulting residue was then purified by silica gel chromatography (solvents noted) and fractions concentrated *in vacuo* to provide the title compounds. The enantioselectivity was determined by chiral HPLC analysis.

**5-(Triisopropyl-silanyloxy)-pentanal.** To a round bottom flask equipped with a magnetic stirring bar was added 5-hydroxypentanal (4.76 mL, 49 mmol), triisopropylsilylchloride (12.6, 58.7 mmol), imidazole (6.67 g, 98 mmol) and CH<sub>2</sub>Cl<sub>2</sub>. After 4 h the reaction was treated with saturated aqueous NH<sub>4</sub>Cl, extracted with CH<sub>2</sub>Cl<sub>2</sub> (100 mL, 3x), and dried over sodium sulfate to provide the title compound as a clear oil (1.56 g, 12% yield) after silica gel chromatography (3% EtOAc/ hexanes). IR (film) 2943, 2892, 2867, 2716, 1728, 1463, 1389, 1389, 1248, 1106, 1071, 1014, 995.9, 919.3, 882.5, 792.6, 724.7, 680.1, 658.3 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 9.76 (t, *J* = 1.9 Hz, 1H, CHO), 3.70 (t, *J* = 6.1 Hz, 2H, CH<sub>2</sub>O), 2.46 (dt, *J* = 1.9, 7.2 Hz, 2H, CH<sub>2</sub>CHO), 1.80- 1.50 (m, 4H, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>), 1.04 (d, *J* = 3.5 Hz, 18H, 6(CH<sub>3</sub>)), 1.12- 0.98 (m, 3H, 3(CHCH<sub>3</sub>)); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ 202.4, 62.7, 43.5, 32.2, 18.6, 17.9, 11.9; HRMS (CI) exact mass calcd for (C<sub>14</sub>H<sub>30</sub>O<sub>2</sub>Si) requires *m/z* 258.2015, found *m/z* 258.2023.

**3-(1-Methyl-1*H*-indol-3-yl)-propionaldehyde.** An amber 2-dram vial equipped with a magnetic stir bar and containing (2*S*, 5*S*)-5-benzyl-2-*tert*-butyl-3-methyl-imidazolidin-4-one•trifluoroacetic acid (1 g, 2.8 mmol) was charged with CH<sub>2</sub>Cl<sub>2</sub> (100 mL), then cooled to -50 °C. The solution is stirred for 5 min before acrolein (12.4 mL, 188 mmol) was added. After stirring for an additional 10 minutes, *N*-methylindole (8 mL, 62 mmol) was added in one portion. The resulting suspension was stirred at constant temperature until complete consumption of the *N*-methylindole as determined by TLC analysis (8 hours). The reaction mixture was then transferred cold through a silica gel plug and the filtrates were concentrated *in vacuo*. The

resulting residue was purified by silica gel chromatography (10% EtOAc/ hexanes) to afford the title compound as a yellow oil (3.5 g, 30% yield). IR (film) 3041, 2915, 2836, 2713, 1716, 1558, 1540, 1472, 1458, 1370, 1319, 1242, 1150, 1124, 1062, 1006  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  9.76 (t,  $J$  = 1.6 Hz, 1H, CHO), 7.70- 7.62 (m, 1H, Ar), 7.40- 7.18 (m, 3H, Ar), 6.91 (s, 1H, CHN), 3.79 (s, 3H,  $\text{CH}_3$ ), 3.18 (t,  $J$  = 7.2 Hz, 2H,  $\text{CH}_2\text{Ar}$ ), 2.89 (dt,  $J$  = 1.0, 7.2 Hz, 2H,  $\text{CH}_2\text{CHO}$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  202.1, 136.7, 127.1, 126.0, 121.3, 118.4, 112.6, 109.0, 43.7, 32.0, 17.3; HRMS (CI) exact mass calcd for ( $\text{C}_{12}\text{H}_{13}\text{NO}$ ) requires  $m/z$  187.0997, found  $m/z$  187.0991.

**(*R*)-2-(*N*-Phenyl-aminoxy)-propan-1-ol (table 3, entry 1).** Prepared according to the general procedure from propionaldehyde (216  $\mu\text{L}$ , 3.00 mmol) for 2 h to provide the title compound as a yellow oil (147.2 mg, 88% yield, 97% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3380, 3275, 2933, 1601, 1493, 1240, 1153, 1045, 898.5, 766.5, 692.5  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.30- 7.22 (m, 2H, ArH), 7.00- 6.92 (m, 3H, ArH), 4.13- 4.20 (m, 1H, CH), 3.76 (dd, 1H,  $J$  = 3.3, 12.1 Hz,  $\text{CH}_2$ ), 3.68 (dd, 1H,  $J$  = 6.6, 12.1 Hz,  $\text{CH}_2$ ), 1.23 (d,  $J$  = 6.6 Hz, 3H,  $\text{CHCH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.4, 128.7, 121.8, 114.3, 79.9, 65.8, 15.4; HRMS (CI) exact mass calcd for ( $\text{C}_9\text{H}_{13}\text{NO}_2$ ) requires  $m/z$  167.0946, found  $m/z$  167.0952.  $[\alpha]_{\text{D}} = + 1.13$  ( $c$  = 1.0,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (10% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_{\text{r}}$  = 34.4 min and (*R*) isomer  $t_{\text{r}}$  = 40.0 min.

**(*R*)-2-(*N*-Phenyl-aminoxy)-hexan-1-ol (table 3, entry 2).** Prepared according to the general procedure from hexanal (240  $\mu\text{L}$ , 2.00 mmol) for 2 h to provide the title compound as a yellow oil (165.2 mg, 79% yield, 98% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3388, 3274, 3052, 1602, 1494, 1467, 1379, 1345, 1305, 1242, 1057, 1027, 898.8  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.27 (t,  $J$  = 7.7 Hz, 2H, ArH), 7.10- 6.93 (m, 3H, ArH), 3.96- 3.68 (m, 1H,  $\text{HOCH}_2\text{CH}$ ), 3.05 (s, 1H, OH), 1.76- 1.22 (m, 6H,  $\text{CH}_2\text{CH}_2\text{CH}_2$ ), 0.92 (t, 3H,  $\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.7, 129.2, 122.5, 115.0, 84.3, 65.4, 30.0, 28.3, 23.2, 14.4; HRMS (CI) exact mass calcd for ( $\text{C}_{12}\text{H}_{19}\text{NO}_2$ ) requires  $m/z$  210.1494, found  $m/z$  210.1501.  $[\alpha]_{\text{D}} = + 19.9$  ( $c$  = 1.0,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD

guard column (5% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_r$  = 25.6 min and (*R*) isomer  $t_r$  = 28.7 min.

**(*R*)-3-Methyl-2-(*N*-phenyl-aminoxy)-butan-1-ol (table 3, entry 3).** Prepared according to the general procedure from isovaleraldehyde (322  $\mu$ L, 3.00 mmol) for 2 h to provide the title compound as a yellow oil (166.0 mg, 85% yield, 99% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3380, 3260, 3046, 2961, 2873, 1602, 1494, 1469, 1390, 1363, 1234, 1051, 1026, 975.0, 898.7, 764.3, 737.7, 692.2  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.34- 7.20 (m, 3H, ArH, NH), 7.03- 6.94 (m, 3H, ArH), 3.92- 3.76 (m, 2H,  $\text{CH}_2$ ), 3.71 (ddd,  $J$  = 2.8, 6.0, 6.0 Hz, 1H, CHO), 3.39 (s, 1H, OH), 2.03 (m, 1H,  $\text{CHMe}_2$ ), 1.06 (d,  $J$  = 6.6 Hz, 3H,  $\text{CHCH}_3$ ), 1.00 (d,  $J$  = 7.1 Hz, 3H,  $\text{CHCH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.2, 128.7, 122.1, 114.7, 88.4, 63.1, 28.6, 18.8, 18.6; HRMS (CI) exact mass calcd for ( $\text{C}_{11}\text{H}_{17}\text{NO}_2$ ) requires  $m/z$  195.1259, found  $m/z$  195.1261.  $[\alpha]_D = + 39.1$  ( $c$  = 1.0,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (5% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_r$  = 19.5 min and (*R*) isomer  $t_r$  = 22.1 min.

**(*R*)-2-(*N*-Phenyl-aminoxy)-pent-4-en-1-ol (table 3, entry 4).** Prepared according to the general procedure from pent-4-enal (296  $\mu$ L, 3.00 mmol) for 2 h to provide the title compound as a yellow oil (155.3 mg, 80% yield, 99% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3383, 3279, 3072, 2916, 1643, 1602, 1493, 1426, 1415, 1348, 1244, 1026, 994.8, 917.0, 740.6, 693.9  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.30- 7.15 (m, 2H, ArH), 7.05 (s, 1H, NH), 7.00- 6.96 (m, 3H, ArH), 5.95- 5.81 (m, 1H,  $\text{CH}=\text{CH}_2$ ), 5.19- 5.10 (m, 2H,  $\text{CH}=\text{CH}_2$ ), 4.03 (dddd,  $J$  = 2.7, 6.6, 6.6, 6.6 Hz, 1H,  $\text{CH}-\text{ON}$ ), 3.89- 3.84 (m, 1H,  $\text{CH}_2\text{OH}$ ), 3.77 (dd,  $J$  = 6.0, 12.0 Hz, 1H,  $\text{CH}_2\text{OH}$ ), 2.56- 2.31 (m, 2H,  $\text{CH}_2\text{CH}=\text{CH}_2$ ), 1.80 (s, 1H, OH);  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.2, 133.9, 128.9, 122.3, 117.6, 114.7, 83.3, 64.5, 34.7; HRMS (CI) exact mass calcd for ( $\text{C}_{11}\text{H}_{15}\text{NO}_2$ ) requires  $m/z$  194.1181, found  $m/z$  194.1173.  $[\alpha]_D = + 8.0$  ( $c$  = 0.83,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (5% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_r$  = 30.6 min and (*R*) isomer  $t_r$  = 36.4 min.

**(*R*)-3-Phenyl-2-(*N*-phenyl-aminoxy)-propan-1-ol (table 3, entry 5).** Prepared according to the general procedure from hydrocinnamaldehyde (260  $\mu$ L, 2.00 mmol) for 4 h to provide the

title compound as a yellow oil (231.0 mg, 95% yield, 97% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3385, 3278, 3055, 3028, 2937, 2880, 1601, 1494, 1455, 1346, 1307, 1239, 1082, 1069, 1030, 898.2  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.44- 7.20 (m, 7H, ArH), 7.01 (t,  $J = 7.7$  Hz, 1H, ArH), 6.86 (d,  $J = 7.7$  Hz, 1H, ArH), 4.16 (dddd,  $J = 2.2, 6.6, 6.6, 6.6$  Hz, 1H, CH), 3.87 (ddd,  $J = 2.7, 6.6, 12.1$  Hz, 1H,  $\text{CH}_2\text{OH}$ ), 3.79- 3.70 (m, 1H,  $\text{CH}_2\text{OH}$ ), 3.06 (dd,  $J = 6.6, 13.7$  Hz, 1H,  $\text{CH}_2\text{Ph}$ ), 3.06 (dd,  $J = 7.1, 13.7$  Hz, 1H,  $\text{CH}_2\text{Ph}$ ), 2.33 (s, 1H, OH);  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.7, 138.3, 129.8, 129.2, 128.7, 126.7, 122.4, 114.8, 85.4, 64.1, 36.9; HRMS (CI) exact mass calcd for ( $\text{C}_{15}\text{H}_{17}\text{NO}_2$ ) requires  $m/z$  244.1338, found  $m/z$  244.1344.  $[\alpha]_{\text{D}} = + 43.1$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (5% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_{\text{r}} = 26.8$  min and (*R*) isomer  $t_{\text{r}} = 28.5$  min.

**(*R*)-2-Phenyl-2-(*N*-phenyl-aminoxy)-ethanol (table 3, entry 6).** Prepared according to the general procedure from phenylacetaldehyde (351  $\mu\text{L}$ , 3.00 mmol) for 2 h to provide the title compound as a yellow oil (137.4 mg, 60% yield, 99% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3389, 3277, 3032, 2918 1601, 1494, 1453, 1414, 1350, 1309, 1232, 1027, 896.7, 759.0, 696.4  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.43- 7.24 (m, 7H, ArH), 7.03- 6.95 (m, 4H, NH, ArH), 5.02 (dd,  $J = 3.3, 8.2$  Hz, 1H, CH), 4.04- 3.92 (m, 1H,  $\text{CH}_2$ ), 3.88- 3.77 (m, 1H,  $\text{CH}_2$ ), 2.66 (dd,  $J = 4.4, 7.7$  Hz, 1H, OH);  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ )  $\delta$  148.2, 138.0, 129.3, 128.9, 128.7, 127.3, 122.8, 115.3, 86.8, 66.7; HRMS (CI) exact mass calcd for ( $\text{C}_{14}\text{H}_{15}\text{NO}_2$ ) requires  $m/z$  229.1103, found  $m/z$  229.1110.  $[\alpha]_{\text{D}} = - 140.7$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (10% ethanol / hexanes, 1 mL/min); (*S*) isomer  $t_{\text{r}} = 26.5$  min and (*R*) isomer  $t_{\text{r}} = 35.0$  min.

**(*R*)- 2-(*N*-Phenyl-aminoxy)-5-(triisopropyl-silanyloxy)-pentan-1-ol (table 3, entry 7).** Prepared according to the general procedure from 5-(triisopropyl-silanyloxy)-pentanal (776 mg, 3.00 mmol) for 2 h to provide the title compound as a yellow oil (267.2 mg, 76% yield, 98% ee) after silica gel chromatography (20% EtOAc/ hexanes). IR (film) 3367, 3261, 2942, 2966 1602, 1494, 1463, 1376, 1243, 1103, 1061, 882.3, 725.2, 689.5  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.34- 7.23 (m, 2H, ArH), 7.08 (s, 1H, NH), 7.03- 6.95 (m, 1H, ArH), 4.00 (dddd,  $J = 2.6, 6.2, 6.2, 6.2$  Hz, 1H, CH), 3.91- 3.66 (m, 4H,  $\text{CH}_2\text{OH}$ ,  $\text{CH}_2\text{OSi}$ ), 2.68 (s, 1H, OH); 1.85- 1.58 (m, 4H,

CH<sub>2</sub>CH<sub>2</sub>), 1.14- 1.02 (m, 21H, (CH(CH<sub>3</sub>)<sub>2</sub>)<sub>3</sub>); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ 148.6, 129.3, 122.7, 115.1, 84.1, 65.6, 63.4, 29.3, 26.5, 18.3, 12.2; HRMS (CI) exact mass calcd for (C<sub>20</sub>H<sub>37</sub>NO<sub>3</sub>Si) requires *m/z* 367.2543, found *m/z* 367.2549. [α]<sub>D</sub> = + 17.1 (c = 1.0, CHCl<sub>3</sub>). The enantiomeric ratio was determined by HPLC using a Chiracel AS and AS guard column (0.2% ethanol / hexanes, 1 mL/min); (*S*) isomer *t<sub>r</sub>* = 74.0 min and (*R*) isomer *t<sub>r</sub>* = 88.6 min.

**(*R*)-3-(1-Methyl-1*H*-indol-3-yl)-2-(*N*-phenyl-aminooxy)-propan-1-ol (table 3, entry 8).**

Prepared according to the general procedure from 3-(1-methyl-1*H*-indol-3-yl)-propionaldehyde (561.7 mg, 3.00 mmol) for 4 h to provide the title compound (83% NMR yield, 98% ee). IR (film) 3401, 3266, 3049, 2928 1601, 1546, 1494, 1473, 1424, 1376, 1328, 1249, 1155, 1127, 1065, 1028, 1012, 898.6, 740.1, 693.9, 565.8 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.70 (dd, *J* = 0.8, 8.0, Hz, 1H, ArH), 7.40- 6.96 (m, 9H, Ar), 4.36- 4.27 (m, 1H, CHON), 3.93 (dd, *J* = 2.7, 12.0 Hz, 1H, CH<sub>2</sub>OH), 3.83 (dd, *J* = 5.8, 12.0 Hz, 1H, CH<sub>2</sub>OH), 3.79 (s, 3H, CH<sub>3</sub>), 3.28 (dd, *J* = 5.8, 14.6 Hz, 1H, CH<sub>2</sub>Ar), 3.07 (dd, *J* = 8.0, 14.6 Hz, 1H, CH<sub>2</sub>Ar); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ 148.5, 136.9, 128.9, 127.9, 127.5, 122.3, 121.6, 118.9, 118.9, 114.7, 110.1, 109.2, 84.3, 64.3, 32.5, 25.6; HRMS (CI) exact mass calcd for (C<sub>18</sub>H<sub>20</sub>N<sub>2</sub>O<sub>2</sub>) requires *m/z* 367.2543, found *m/z* 367.2549. [α]<sub>D</sub> = + 25.7 (c = 1.0, CHCl<sub>3</sub>). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (15% ethanol / hexanes, 1 mL/min); (*S*) isomer *t<sub>r</sub>* = 25.6 min and (*R*) isomer *t<sub>r</sub>* = 32.5 min.

**(*R*)-*O*-(2-Dibenzylamino-1-methyl-ethyl)-*N*-phenyl-hydroxylamine (equation 3).** To a 2-dram vial equipped with a magnetic stir bar and charged with L-proline was added chloroform (500 μL) and the suspension cooled to 4 °C. After 10 minutes, nitrosobenzene (107.1 mg, 1 mmol) was added in one portion at which time the solution became green. To the green heterogeneous solution was added propionaldehyde (216 μL, 3 mmol) in one portion. The resulting solution was stirred at 4 °C until the reaction was determined to be complete by TLC and the disappearance of the green color in solution, resulting in a final yellow homogeneous solution (2 h). The reaction mixture was then concentrated and transferred, using CH<sub>2</sub>Cl<sub>2</sub> (2 mL), to a vial at 0 °C containing dibenzylamine (385 μL, 2.0 mmol) and sodium triacetoxymethylborohydride (424 mg, 2.0 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (6 mL). After stirring at 0 °C for 6 h the resulting solution was treated with saturated aqueous NaHCO<sub>3</sub>, extracted with CH<sub>2</sub>Cl<sub>2</sub> (3 x

30 mL), dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The resulting residue was then purified by silica gel chromatography (10% EtOAc/ hexanes) and the fractions concentrated *in vacuo* to provide the title compound as a yellow oil (267.2 mg, 71% yield, 96% ee). IR (film) 3383, 3048, 3027, 2971, 2930, 2799, 1602, 1494, 1452, 1372, 1334, 1307, 1243, 1121, 1077, 1059, 1028, 977.3, 892.5, 864.3, 737.3, 697.5, 484.3 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.58-6.97 (m, 16H, ArH, NH), 4.32- 4.18 (m, 1H, CH), 3.85 (d, *J* = 13.4 Hz, 2H, (CH<sub>2</sub>Ar)<sub>2</sub>), 3.72 (d, *J* = 13.4 Hz, 2H, (CH<sub>2</sub>Ar)<sub>2</sub>), 2.94 (dd, *J* = 7.0, 13.5 Hz, 1H, CH<sub>2</sub>CH), 2.61 (dd, *J* = 4.7, 13.5 Hz, 1H, CH<sub>2</sub>CH), 1.35 (s, *J* = 6.2 Hz, 3H, CH<sub>3</sub>); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ 149.5, 139.8, 129.4, 129.2, 129.1, 128.8, 128.7, 128.5, 127.4, 121.7, 114.4, 59.6, 58.6, 18.1; HRMS (CI) exact mass calcd for (C<sub>23</sub>H<sub>26</sub>N<sub>2</sub>O) requires *m/z* 347.2123, found *m/z* 347.2126. [α]<sub>D</sub> = + 29.1 (c = 1.0, CHCl<sub>3</sub>). The enantiomeric ratio was determined by HPLC using a Chiracel AD and AD guard column (5.0% isopropanol / hexanes, 1 mL/min); (*S*) isomer *t*<sub>r</sub> = 14.6 min and (*R*) isomer *t*<sub>r</sub> = 25.0 min.

### Stereochemical Analysis

**Procedure for CuSO<sub>4</sub> N–O bond cleavage:** To a 2-dram vial equipped with a magnetic stir bar and charged with the appropriate oxy–aniline adduct was added methanol (3 mL) and the solution cooled to 4 °C. After 10 minutes, copper sulfate (30 mmol %) was added in one portion. The resulting solution was then stirred at 4 °C until the reaction was determined to be complete by TLC analysis. The reaction was then treated with saturated aqueous sodium chloride, extracted with EtOAc (3 x 30 mL), dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The resulting residue was purified by silica gel chromatography (50% EtOAc / hexanes) and fractions concentrated *in vacuo* to provide the title compounds.

**(*R*)-Hexane-1,2-diol.** Prepared according to the procedure for CuSO<sub>4</sub> N–O bond cleavage from (*R*)-2-(*N*-phenyl-aminoxy)-hexan-1-ol (207 mg, 1 mmol) for 12 h to provide the title compound as a colorless oil (56.9 mg, 48% yield). The title compound was identical in all

respects to the known literature compound.<sup>3</sup>  $[\alpha]_{\text{D}} = + 15.7$  ( $c = 1.0$ , EtOH); reported rotation for (*S*)-hexane-1,2-diol  $[\alpha]_{\text{D}} = - 22.1$  ( $c = 1.0$ , EtOH).<sup>3</sup>

**(*R*)-3-Phenyl-propane-1,2-diol.** Prepared according to the procedure for CuSO<sub>4</sub> N–O bond cleavage from (*R*)-3-phenyl-2-(*N*-phenyl-aminooxy)-propan-1-ol (243.3 mg, 1 mmol) for 12 h to provide the title compound as a colorless oil (80.2 mg, 68% yield). The title compound was identical in all respects to the known literature compound.<sup>3</sup>  $[\alpha]_{\text{D}} = + 25.5$  ( $c = 1.0$ , EtOH); reported rotation for (*S*)-3-Phenyl-propane-1,2-diol  $[\alpha]_{\text{D}} = - 29.5$  ( $c = 1.0$ , EtOH).<sup>3</sup>

**(*R*)-1-Phenyl-ethane-1,2-diol.** Prepared according to the procedure for CuSO<sub>4</sub> N–O bond cleavage from (*R*)-2-phenyl-2-(*N*-phenyl-aminooxy)-ethanol (230 mg, 1 mmol) for 3 h to provide the title compound as a colorless oil (71.9 mg, 52% yield). The title compound was identical in all respects to the known literature compound.<sup>4</sup>  $[\alpha]_{\text{D}} = + 25.5$  ( $c = 1.0$ , EtOH); reported rotation for (*S*)-1-Phenyl-ethane-1,2-diol  $[\alpha]_{\text{D}} = - 24.7$  ( $c = 1.0$ , EtOH).

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<sup>3</sup> Hasegawa, J.; Ogura, M.; Tsuda, S.; Maemoto, S.; Kutsuki, H.; Ohashi, T. *Agric. Biol. Chem.* **1990**, *54*, 1819.

<sup>4</sup> Robinson, P. L.; Barry, C. N.; Kelly, J. W.; Evans, S. A., Jr. *J. Am. Chem. Soc.* **1985**, *107*, 5210.